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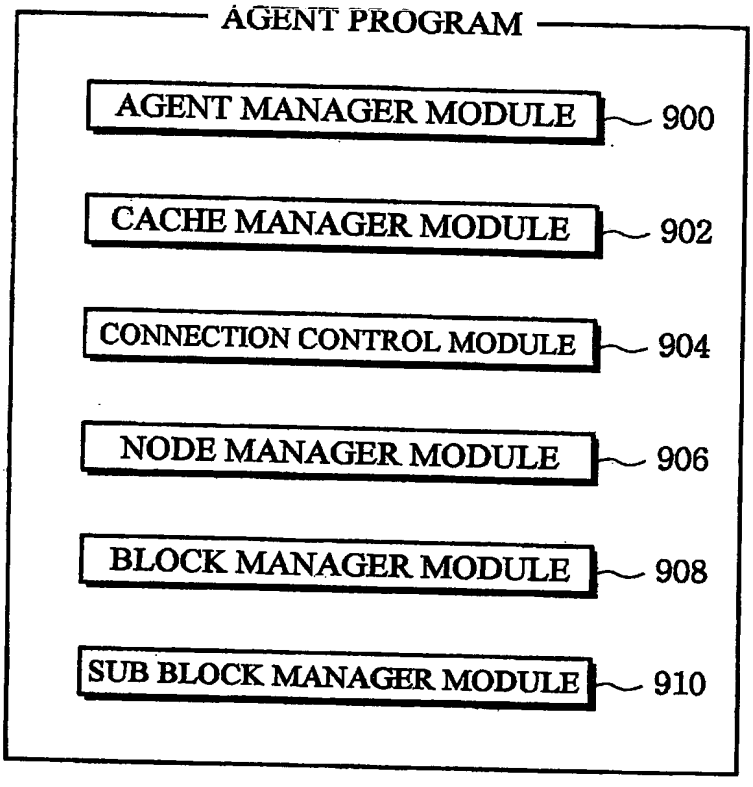
(54) Title: METHOD FOR TRANSMITTING AND DOWNLOADING STREAMING DATA



(57) Abstract: A method for transmitting and downloading streaming data is disclosed. The method comprises (a) establishing connections with a plurality of nodes; (b) sending a request for sub blocks of streaming data to the plurality of nodes where connection is established to download the sub blocks; (c) monitoring download state of the established connections; and (d) redistributing sub Blocks to be downloaded from some of the nodes where connection is established according to the monitoring result; wherein, the step (b) to step (d) are repeated for downloading sub blocks included in next block when all sub Blocks included in a block are downloaded.

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METHOD FOR TRANSMITTING AND DOWNLOADING STREAMING DATA

Field of the Invention

The present invention relates to a method for transmitting and downloading streaming data, more particularly to a method for transmitting and downloading streaming data through plurality of distributed nodes.

Background of the Invention

Conventionally, most contents data provided through the Internet were small size data such as document or picture. However, as data transmission technology and devices develop, multimedia contents are also widely provided. The multimedia contents are transmitted to user clients through streaming method.

Conventionally, streaming data were transmitted from one server to user clients.

The streaming data should be transmitted in real time. However, as the streaming data were transmitted from one server to user clients conventionally, transmission delay has occurred frequently when load of the server becomes higher or connection state is instable. Because the streaming data should be played as soon as they are downloaded, transmission delay affects QoS (Quality of Service) greatly unlike general file download.

As a prior art regarding file download, US patent 6,339,785 discloses a method for downloading files through multiple servers. According to the US

patent 6,339,785, total file is divided by N and file is downloaded through N servers so that file can be transmitted stably although error occurs in one connection.

However, according to the above file download method, the file is available only after whole data are downloaded. Therefore, the download method of US 6,339,785 can not be applied to streaming data that should be played as soon as they are downloaded.

Detailed Description of the Invention

In order to solve the above mentioned problems, the present invention intends to provide a method for transmitting and downloading streaming data through a plurality of nodes.

Another object of the present invention is to provide a method for downloading streaming data stably from plurality of user clients in P2P network and a communication agent program installed in user clients.

Another object of the present invention is to provide a method for downloading streaming data stably in file transmission system with multiple servers and a communication agent program installed in user clients.

Another object of the present invention is to provide a method for dividing streaming data into blocks and sub blocks and downloading data from plurality of connections.

In order to achieve above-mentioned objects, according to a preferred embodiment of the present invention, there is provided .a method for downloading streaming data comprising the steps of: (a) establishing connections with a plurality of nodes; (b) sending a request for sub blocks of streaming data to the plurality of

nodes where connection is established to download the sub blocks; (c) monitoring download state of the established connections; and (d) redistributing sub blocks to be downloaded from some of the nodes where connection is established according to the monitoring result; wherein, the step (b) to step (d) are repeated for downloading sub blocks included in next block when all sub blocks included in a block are downloaded

According to the present invention, the step of determining sub blocks to download from each of the nodes where connection is established may be further comprised.

The step (c) may comprise the step of monitoring if there exists a connection where sub block download is completed.

The sub blocks to be downloaded from each of the nodes may be determined by calculating connection state valuation index.

The connection state valuation index may be calculated using information selected from group consisting of round-trip time with each of the nodes and average download speed from each of the nodes.

The step (d) may comprise the step of redistributing sub blocks between a connection where sub block download is completed and some of the connections where sub block download is not completed when a connection where sub block download is completed exists.

The step (d) may comprise the step of redistributing sub blocks between a connection where sub block download is completed and a connection of which download rate is the lowest among connections where sub block download is not completed.

The step for redistributing sub blocks between a connection where sub

block download is completed and a connection of which the download rate is the lowest may comprise the steps of: determining download speed of the connection where the sub block download is completed and the connection of which the download rate is the lowest; determining the number of remaining sub blocks to download in the connection of which the download rate is the lowest; determining if redistribution of sub blocks is necessary; redistributing the remaining sub blocks between the connection where sub block download is completed and the connection of which the download rate is the lowest according to rate of the download speed if sub block redistribution is necessary

According to another embodiment of the present invention, there is provided a communication agent program installed in a plurality user clients in the system where a connection control server and the plurality of user clients are connected through network, comprising: an agent manager module for providing information of contents stored in a user client and identification information of the user client to the connection control server and transmitting contents request information to the connection control server when a user requests contents; a node information manager module for receiving and storing list information of nodes that store requested contents; a connection control module for establishing connections with a plurality of nodes using the list information of nodes, and determining sub blocks to download from each of the nodes where connection is established to request sub blocks, and redistributing sub blocks to download from some of the connected nodes by monitoring download state while downloading sub blocks; a sub block manager module for determining if all sub blocks included in a block are downloaded and requesting sub blocks included in a next block to download sub blocks included in the next block when all sub blocks included in a block is

downloaded.

According to another embodiment of the present invention, there is provided a communication agent program installed in user clients downloading streaming data from system including a plurality of contents servers and at least a connection control server, comprising: a data request module for sending a request for transmission of data to the connection control server; a node information manager module for receiving and storing list of contents servers from which the requested data are to be downloaded; a connection control module for establishing connections with a plurality of contents servers included in the contents server list, and requesting sub blocks of streaming data to download from the contents servers where connection is established, and redistributing sub blocks to download in some of the contents servers where connection is established by monitoring download state while downloading sub blocks from connected contents servers; and a sub block manager module for determining if all sub blocks included in a block are downloaded and requesting sub blocks included in a next block to download sub blocks of the next block when all sub blocks included in a block are downloaded.

According to another embodiment of the present invention, there is provided a connection control server connected with a plurality of user clients through network for controlling connection between the user clients in order for a user client to download streaming data by connecting other user clients, comprising: a mesh manager module for receiving information of contents stored in the connected plurality of user clients and address information of the connected plurality of user clients, and providing information of nodes that store requested contents to a user client which requested contents; and a mesh information database for storing information of contents stored in each of the user clients and address

information of each of the user clients; wherein a communication agent program is installed in the plurality of user clients, the communication agent program controls user clients to establish connections with a plurality of nodes using the node information, and to send a request for sub blocks of streaming data to download to the connected nodes, and to redistribute sub blocks to download by monitoring download state of each of the connected nodes.

According to another embodiment of the present invention, there is provided a connection control server connected with a plurality of user clients and a plurality of contents servers through network for controlling connection between the user clients and the contents servers in order for a user client to download streaming data by connecting at least two contents servers, comprising: a server state determining module for receiving state information from the connected plurality of contents servers and determining state of each of the contents servers; a server list providing module for providing list information of servers to transmit streaming data of requested contents when receiving contents request information from a user client; wherein a communication agent program is installed in the user clients, the communication agent program controls the user clients to establish connections with at least two contents servers using the server list information, and determine sub blocks of streaming data to download from each of the connected contents servers to request sub blocks, and to redistribute sub blocks to download by monitoring download state of sub blocks from each of the connected nodes.

Brief Description of the Drawings

FIG. 1 is a schematic configuration of streaming data transmission system

where the present invention is applied.

FIG. 2 is an example of network system where the method for transmitting streaming data according to the present invention is applied.

FIG. 3 is another example of network system where streaming data transmission method of the present invention is applied.

FIG. 4 is another example of network system where streaming data transmission method of the present invention is applied.

FIG. 5 is a structure of streaming data according to a preferred embodiment of the present invention.

FIG. 6 is a flow chart of streaming data download method according to a preferred embodiment of the present invention.

FIG. 7 is a flowchart of operation of the connection control server according to a preferred embodiment of the present invention.

FIG. 8 is a flow chart of operation of the connection control server according to another embodiment of the present invention.

FIG. 9 is a block diagram of agent program installed in the user client according to a preferred embodiment of the present invention.

FIG. 10 is a detailed block diagram of the connection control module according to a preferred embodiment of the present invention.

FIG. 11 is a flow chart of process that sub block is redistributed by determining connection state according to a preferred embodiment of the present invention.

FIG. 12 is a flow chart of process that is performed when there exists a connection where sub block download is completed according to a preferred embodiment of the present invention.

FIG. 13 is a block diagram of module of the connection control server according to a preferred embodiment of the present invention.

FIG. 14 is a block diagram of the module of the connection control server according to another embodiment of the present invention.

Best Mode for Carrying out the Invention

The present invention will be described by virtue of the following embodiments in more detail.

FIG. 1 is a schematic configuration of streaming data transmission system where the present invention is applied.

Referring to FIG. 1, the streaming data transmission system according to the present invention may comprise a plurality of nodes 100, 102, 104, 106, 108, 110 and a user client 112.

The user client establishes connections with selected plurality of nodes 102, 106, 108 and downloads streaming data.

In FIG. 1, the plurality of nodes 100, 102, 104, 106, 108, 110 store contents data and transmit requested contents data to the user client after receiving contents request information from the user client. The node may be a server that generally transmits contents or other user client.

The user client 112 transmits contents request information to the plurality of nodes and downloads contents data from corresponding nodes 102, 106, 108. In other words, according to the present invention, streaming data are downloaded from plurality of paths through plurality of nodes.

At this time, the user client sends a request for different streaming data to

each of the nodes where connection is established and assembles the streaming data downloaded form the plurality of nodes.

FIG. 5 is a structure of streaming data according to a preferred embodiment of the present invention.

Referring to FIG. 5, the streaming data according to the present invention comprise a plurality of blocks 500 and each of the blocks comprises a plurality of sub blocks 502.

The block and sub block are logical unit for classifying streaming data and it would be obvious to those skilled in the art that other terms can be used.

Unlike general file download, the streaming data should be played while being downloaded. Therefore, general file download method through multiple servers cannot be applied to the streaming data download because conventionally whole file data are divided into N segments and each of the segments is downloaded through multiple paths. According to the conventional file download method using multiple paths, downloaded file cannot be played until whole file data are downloaded while streaming data should be played as soon as they are downloaded.

Therefore, according to the present invention, whole streaming data are divided into blocks and sub blocks included in a block are downloaded in parallel/distribution method through multi-paths.

For example, in the system of FIG. 1, if one block comprises ten sub blocks, the user client 112 requests 1~3 sub blocks to the second node 102, 4~7 sub blocks to the fourth node 106 and 8~10 sub blocks to the fifth node 108.

If all sub blocks included in a block are downloaded, the user client 112 requests sub blocks included in the next block. After all data of a block are downloaded, sub blocks of the next block are downloaded, and therefore data can

be played while being downloaded although data are downloaded in multi-paths.

In FIG. 5, the case where the streaming data are divided into blocks and sub blocks, however, it would be obvious to those skilled in the art that the streaming data can be divided into smaller units than the sub block and can be transmitted by the smaller units.

When the user client sends a request for sub blocks to each of the nodes, the user client determines the connection state of each node. For example, among the second node 102, the fourth node 106 and the fifth node 108, if the connection state of the second node 102 is the best and the connection state of the fifth node is the worst, the user client 112 sends a request for the maximum number of sub blocks to the second node and minimum number of sub blocks to the fifth node. The method for determining the state of the node and requesting sub blocks according to the result of determination will be explained in more detail referring to another figure.

When sub blocks are downloaded through the multi-paths, sub block download in a connection can be completed earlier than in other connections, and in this case, data are not transmitted in the connection where sub block download is completed until sub block download is completed in other connections. Idle connection of this type reduces transmission efficiency.

Therefore, according to the present invention, if sub block download is completed in a connection among the plurality of connections, some sub blocks which are not transmitted are downloaded through the connection where the sub block download is completed. The method for redistributing sub blocks to be downloaded when a sub block download is completed in a connection will be explained in more detail referring to another figure.

FIG. 2 is an example of network system where the method for transmitting

streaming data according to the present invention is applied.

FIG. 2 illustrates a case where streaming data transmission method using P2P (Peer to Peer) is applied.

Referring to FIG. 2, the network system where the present invention is applied may comprise a connection control server 200 and a plurality of clients 202, 204, 206, 208, 210, 212, 214, and 216.

The connection control server 200 receives contents request information from a user client and provides address information of other user clients that store the requested contents to the user client that requested contents in response to the contents request information. The user client that requested contents downloads streaming data of contents through multi-paths using the provided address information.

For example, if a user client 210 requests movie 'A' to the connection control server 200, the connection control server 200 derives address information of user clients that store movie 'A' and provides the address information to the user client 210 that requested the contents.

The address information may be IP address and port number and it would be obvious to those skilled in the art that other address identification information can be used.

For example, let us assume that the user clients that store the movie 'A' are reference number 202, 204 and 208 in FIG. 2. If the connection control server provides address information of clients 201, 204, 208 to the user client 210 that requested contents, the user client 210 tries connection establishment with the user clients 202, 204, and 208.

If the connection is established, the user client 210 requests different sub

blocks to each of the clients 202, 204, 208 where connection is established. If all sub blocks included in a block are downloaded, the user client 210 requests sub blocks included in the next block. The transmitted streaming data are stored in the user client. If other clients request the streaming data, the stored streaming data are transmitted.

A communication agent program for communication with the connection control server or other clients is installed in each of the user clients. In the embodiment of the present invention, the case where the communication agent is computer software is described, however, it would be apparent to those skilled in the art that the communication agent may be an independent device or a card.

If power of a client where the communication agent is installed is on or the communication agent is executed, the agent program transmits information of contents stored in the user client to the connection control server 200 and the connection control server 200 stores the transmitted information.

FIG. 3 is another example of network system where streaming data transmission method of the present invention is applied.

FIG. 3 illustrates a case where streaming data are provided through multiple servers.

Referring to FIG. 3, the streaming data transmission system according to an embodiment of the present invention may comprise a plurality of contents servers 300, 302, 304, 306, 308, a connection control server 310 and a user client 312.

The connection control server 310 receives contents request information from the user client 312 and provides information of servers where the user client should be connected among the plurality of servers 300, 302, 304, 306, 308.

The connection control server 310 receives state information from the

plurality of servers 300, 302, 304, 306, 308 periodically and controls the user client to be connected to the servers with good state.

The user client 312 receives server list information from the connection control server 310 and establishes connection with the contents servers in the list to download streaming data through multiple paths.

As in the case of FIG. 2, a communication agent program is installed in the user client for downloading streaming data through multiple paths.

FIG. 4 is another example of network system where streaming data transmission method of the present invention is applied.

FIG. 4 is a system where P2P (Peer to Peer) system of FIG.2 and multiple server system of FIG. 3 are combined.

Referring to FIG. 4, the streaming data transmission system according to a preferred embodiment of the present invention may comprise a connection control server 410, a plurality of contents servers 400, 402, 404, 406, 408 and a plurality of clients 412, 414, 416, 418, 420, 422, 424, 426, 428. Although the plurality of contents servers are illustrated in FIG. 4, the number of contents server can be one unlike FIG. 4.

In FIG. 4, the connection control server 410 receives contents request information from user clients, and provides list information of servers or user clients that store the requested contents.

Like FIG. 2 and FIG. 3, an agent program is installed in the user clients 412, 414, 416, 418, 420, 422, 424, 426, 428 and the agent program transmits contents information stored in the client to the connection control server 410 when power of the client is on or the agent program is executed.

The user client that requested contents establishes connection with contents

servers or clients using the list information that is provided by the connection control server 410 and sends a request for different sub blocks to the clients or contents servers where connection is established to download streaming data.

In case of FIG. 4, the node list provided by the connection control server 410 can include user clients and server together. For example, if contents data are received from 5 nodes, one node may be a contents server and other 4 nodes are user clients. In this case, according to a preferred embodiment of the present invention, in order to reduce load of the contents server, contents server can be excluded from nodes if download state from user clients besides contents server is good. Further, the number of sub blocks requested to the contents server can be reduced.

In FIG.2 to FIG. 4, systems which can download streaming data through multiple paths are described. It would be obvious to those skilled in the art that others systems which transmit data through plurality of nodes besides systems of FIG. 2 to FIG. 4 can be applied to the present invention.

FIG. 6 is a flow chart of streaming data download method according to a preferred embodiment of the present invention.

Referring to FIG. 6, a user client receives node list information from the connection control server S600. In system of FIG. 2, nodes are user clients that stores contents. In system of FIG. 3, nodes are plurality of contents servers, and in system of FIG. 4, nodes can include both of user clients and contents server.

If node list information is received, the user client establishes connections with some or all of nodes included in the node list S602. According to a preferred embodiment of the present invention, the user client establishes TCP connection, and other connection establishment method can be used. If connection

establishment fails, information of nodes where connection establishment failed is stored in a black list queue, and connection establishment is not tried for nodes stored in the black list queue in following connection establishment.

If connection is established, the user client determines connection state with nodes and determines sub block number to be downloaded form the nodes S604.

According to an embodiment of the present invention, the connection state is determined by round-trip time with each node or download speed from each node.

According to another embodiment of the present invention, sub blocks to be downloaded can be determined without connection state information in initial state of download. For example, if streaming data are downloaded from 3 nodes and one block comprises 15 sub blocks, the user clients requests 5 sub blocks for each of the 3 nodes.

If sub blocks to be downloaded from each of the nodes are determined, the user clients send a request for transmission of sub blocks to the nodes where connection is established S606. The user client may send a request for sub blocks to all nodes where connection is established or to some of the nodes where connection is established.

The user client downloads sub blocks from nodes where connection is established S608. Although it is not shown in FIG. 6, the user client determines if download error occurs while receiving sub blocks. According to a preferred embodiment of the present invention, occurrence of download error is determined by checking checksum value of sub blocks.

Alternatively, download error can also be determined by checking the checksum value of block after receiving all blocks.

While receiving sub blocks, the user client determines if a connection where

all requested sub blocks are downloaded exists S610.

If there exists a connection where all requested sub blocks are downloaded, the user client redistributes sub blocks of which the download is not completed to the connection where sub block download is completed to download redistributed sub blocks from the connection so that the connection where the sub block download is completed does not become idle state.

The user client determines if all sub blocks included in a block are downloaded S614.

If all sub blocks are downloaded, the user client repeats the process that determines numbers of sub blocks in the next block to be downloaded from each of the nodes through multiple paths S604.

The steps from S610 to S614 are repeated until all sub blocks included in a block are received.

As described referring to FIG. 6, according to the present invention, if sub block download is completed in a path(=connection), sub blocks to be downloaded from each of the nodes are redistributed in order to avoid occurrence of idle connection, by which data download efficiency can be improved.

In FIG. 6, a case that sub blocks are redistributed for the nodes that are transmitting streaming data to the user client. However, it would be obvious to those skilled in the art that sub blocks can also be redistributed for the nodes that are not transmitting sub blocks by monitoring the state of nodes to which sub block transmission is not requested.

Further, although it is not shown in FIG. 6, the download mode can be changed so that streaming data are downloaded from a singular server as conventional method if streaming data cannot be downloaded from the plurality of

nodes.

FIG. 7 is a flowchart of operation of the connection control server according to a preferred embodiment of the present invention.

FIG. 7 illustrates operation of the connection control server in P2P network of FIG. 2 or network where P2P and multiple severs are combined.

Referring to FIG. 7, the connection control server receives address information and contents information from the connected nodes S700. As described above, the communication agent program is installed in the each of the user client (node) and the communication agent program transmits information of contents stored in the user client and information of address of the user client to the connection control server. The received node address information and node contents information are stored in the database of the connection control server.

The connection control server receives contents request information from connected nodes S702. Using the information received in step S700, the connection control server that received contents request information searches node that stores the requested contents S704.

The connection control server provides node list information to the user client that requested contents data S706.

Although it is not shown in FIG. 7, the connection control server may also receive node state information (for example, PING information) and may provide received node state information together with the node list information to the user client.

After receiving node list information, the user client selects node where connection is to be established using the state information. If connection establishment fails or data download rate is not good, the user client selects new

nodes where connection is to be established using the node state information. The node state information can be updated continuously, the updated information is provided to the user client which requested contents data or is downloading data.

FIG. 8 is a flow chart of operation of the connection control server according to another embodiment of the present invention.

FIG. 8 illustrates operation of the connection control server network using multiple servers, such as FIG. 3.

Referring to FIG. 8, the connection control server receives state information from each of the contents servers S800. According to a preferred embodiment of the present invention, the state information may be one or combination selected from group comprising bandwidth information, CPU usage rate information, memory usage rate information, the number of users connected, and file I/O information. It would be obvious to those skilled in the art that other information besides above-described information can also be used as the state information of server.

The connection control server receives contents request information from a user client S802.

The connection control server that received contents request information provides address information of servers with good state (in other words, node list information) using the state information in S800 and sub block distribution information (information on which sub blocks to be downloaded from each of the contents servers) to the client that requested contents S804.

In FIG. 8, the case that sub block distribution information is transmitted to the user client from the connection control server, however, it would be obvious to those skilled in the art that the client itself can distribute sub blocks to download by

checking the connection state after connecting the contents servers.

According to another embodiment of the present invention, in initial state of data download, the connection control server provides sub block distribution information. Then, if download of a block data is completed, the user client itself distributes sub blocks to download from each of the contents servers in the download of the next sub block because contents server can determine download speed with each of the contents servers.

FIG. 9 is a block diagram of agent program installed in the user client according to a preferred embodiment of the present invention.

Referring to FIG. 9, the communication agent program according to a preferred embodiment of the present invention may comprise an agent manager module 900, a cache manager module 902, a connection control module 904, a node manager module 906, a block manager module 908 and a sub block manager module 910.

In FIG. 9, the agent manager module 900 performs communication with the connection control server and provides user client information including IP address and port number and information of contents stored in the user client to the connection control server when the power of the user client is on or the agent program is executed.

Further, the agent manager module 900 provides contents request information to the connection control server when user requests contents. The agent manager module may provide meta information of the contents to a player which plays contents data when meta information is necessary for play of the requested contents.

The cache manager module 902 manages streaming data downloaded from

nodes. The cache manager module 902 provides information for remaining capacity of the cache and information of contents stored in the cache. The cache manager module 902 provides information of contents stored in the cache when power of the user client is on or the agent program is executed. According to a preferred embodiment of the present invention, the cache manager module 902 scrambles the downloaded data when the downloaded data are stored.

The connection control module 904 establishes connections with predetermined number of nodes using the node list information received from the connection control server. The connection control module 904 distributes sub blocks to download from each of the nodes by determining the connection state of nodes and requests sub blocks to each of the nodes according to the distribution result.

Further, the connection control module 904 monitors the download states with each of the nodes continuously, and redistributes sub blocks to download from each of the nodes according to the monitoring result.

According to a preferred embodiment of the present invention, the connection control module 904 monitors if there exists connection where sub blocks download is completed, and the connection control module 904 redistributes sub blocks between the connection where sub block download is completed and some of the connections where sub block download is not completed to avoid idle connection.

According to another embodiment of the present invention, sub blocks can be redistributed previously according to the download state with each of the nodes although the connection where the sub block receipt is not completed does not exist.

According to anther embodiment of the present invention, the connection

control module monitors state information of nodes where connection is not established, and redistributes sub blocks between some of the nodes that are transmitting data and some of the nodes that are not transmitting data.

As mentioned above, in the system of FIG. 4, the connection control module requests data to both of the server and the user clients, and if the download state from the user clients is good, the server may be excluded from nodes or small amount of data may be requested to the server in order to reduce load of the server.

The node manager module 906 provides node list information provided from the connection control server to the connection control module 904. As described above, the node list information may include IP address and port number. According to a preferred embodiment of the present invention, the agent manager module 900 requests information of nodes that store the requested contents and provides the node list information to the node manager module 906. The node information is updated continuously because power of nodes may be off or connection state may become instable.

The sub block manager module 910 downloads sub blocks from nodes and determines if all sub blocks included in a block are downloaded. If all sub blocks are downloaded, the sub block manager module 910 provides downloaded block data to the block manager module 908. If the sub block manager module determines all sub blocks included in a block are downloaded, the connection control module requests sub blocks of the next block.

The block manager module 908 provides received block data to a player which plays streaming data or to the cache manager module.

Although it is not shown in FIG. 9, a reservation manager module can be further included in the communication agent program. When streaming data are

transmitted with high speed, there may occur a case that the client cannot download data at predetermined speed on account of instability of internet connection state. At this case, the movie data are pre-stored in the cache through the reservation manager module before playing of the movie data and the reservation manager module performs processes for the reservation.

The reservation manager module manages information on streaming data which a user requested for reservation and monitors if the reserved contents are received. The reservation manager module requests data through the connection control module until the download of requested data is completed.

FIG. 10 is a detailed block diagram of the connection control module according to a preferred embodiment of the present invention.

Referring to FIG. 10, the connection control module may comprise a connection establishment module 1000, a connection state determining module 1002, a sub block distribution module 1004 and a download state monitoring module 1006.

The connection establishment module 1000 establishes connections with nodes from which data are to be downloaded using the node list information provided from the connection control server. The connection establishment may comprise following steps;

(i) A user client sends a request for TCP connection to a node.

(ii) The node determines if the TCP connection can be allowed.

(iii) The node allows TCP connection.

As explained above, other connection establishment methods other than TCP can be employed.

The connection state determining module 1002 determines the connection

state with each of the nodes. The connection state determining module 1002 calculates connection state valuation index for determining connection state.

According to an embodiment of the present invention, the connection state valuation index may be calculated using round-trip time with each of the nodes.

According to another embodiment of the present invention, the connection state valuation index can be calculated using download speed information from each of the nodes. Alternatively, both of the round-trip time and download speed can be used for calculation of connection state valuation index.

It is desirable that the connection state valuation index is calculated using the round-trip time initially, because download speed is not known initially, and the connection state valuation index is calculated using the download speed after data download is performed. As the download speed changes continuously, the connection state valuation index is also updated depending on the change of download speed.

According to another embodiment of the present invention, the connection state determining module receives information on state of servers from the servers and determines the connection state using the state information.

The sub block distribution module 1004 distributes sub blocks using the connection state valuation index calculated by the connection state determining module 1002. It is preferable that the sub block distribution module 1004 determines the number of sub blocks to download from each of the nodes according to the ratio of connection state valuation index.

The download state monitoring module 1006 determines if there exists a connection where sub block download is completed and requests sub block redistribution to the sub block manager module 1004 when a connection where sub

block download is completed exists.

It is not efficient if sub blocks are redistributed for all connected nodes, because control signal should be transmitted to the all nodes. Therefore, according to a preferred embodiment of the present invention, sub blocks are redistributed between a connection where sub block download is completed and a connection of which the download rate is the lowest. At this case, control signal is transmitted to only the node which completed the sub block transmission and the node of which data transmission rate is the lowest.

FIG. 11 is a flow chart of process that sub block is redistributed by determining connection state according to a preferred embodiment of the present invention.

Referring to FIG. 11, round-trip times with each of the connected nodes are measured in initial state of download S1100. Round-trip time means time duration between transmitting check signal to a connected node and receiving the response signal of the check signal.

After measuring round-trip signal, it is determined if average download speed can be known in all connections S1102. If several blocks are downloaded, average download speed in all connections can be known.

When average download speed in all connections can be known, the connection state valuation index is calculated using the average download speed information S1104. For example, when streaming data are downloaded from 3 nodes and average download speed of 3 nodes is 500,000bps, 100,000bps and 64,000bps, the connection state valuation index in each connection is 500,000, 100,000 and 64,000 respectively. Normalized value of average download speed can also be used as connection state valuation index.

When average download speed in all connections cannot be known, it is determined if average download speed in some of the connections can be known S1106. This case can occur when streaming data are downloaded from new node while downloading streaming data.

When average download speed can be known in some of the connections, the connection state valuation index is calculated using round-trip time and average download speed S1108.

For example, assuming that streaming data are downloaded from 3 nodes, and average download speed of the first node is 200,000bps, average download speed of the second node is 100,000bps and average download speed of the third node is not known. Further, assuming that round-trip time of the first node is 23ms, round-trip time of the second node is 32ms and round trip time of the third node is 20ms.

In this case, the connection state valuation index is calculated by (download speed)/(round-trip time). Average download speed of the third node is predicted using the value of which the (download speed)/(round-trip time) is the smallest. As the (download speed)/(round-trip time) of the second node is the smallest, the average download speed of the third node is calculated by the following equation 1.

[Equation 1]

$$\frac{100,000}{20} \times 32 = 160,500$$

If average download speed in all connections cannot be known, the connection state valuation index is calculated using round-trip time. According to

an embodiment of the present invention, reciprocal of the round-trip time can be used as the connection state valuation index.

For example, assuming that streaming data are downloaded from 3 nodes and round-trip time of each node is 23ms, 41ms and 32ms. In this case, the connection state valuation index of each node may be 1/23, 1/42 and 1/32 respectively.

After calculation of connection state valuation index, the number of sub block to be downloaded from each of the nodes among all sub blocks is determined.

The number of sub block to be downloaded from each of the nodes determined by the connection state valuation index. In more detail, the number of sub block to be downloaded is determined by the following equation 2.

[equation 2]

$$P_i=[\frac{\alpha_i}{\sum_{k=1}^{n}} \times (The\ number\ of\ total\ sub\ blocks)]$$

, where i=1 ~ n-1

$$P_i=(The\ Number\ of\ total\ sub\ blocks)-\sum_{k=1}^{n-1}P_i$$

, where i=n

Wherein, P_i is the number of sub block to be requested to each of the nodes, α_i is connection state valuation index in each of the connections. In other words, the user client requests sub block of which the number is P_i to each node.

FIG. 12 is a flow chart of process that is performed when there exists a connection where sub block download is completed according to a preferred

embodiment of the present invention.

Referring to FIG. 12, the download state monitoring module of the connection control module monitors if there exists a connection where sub block download is completed S1200.

If there exists a connection where sub block download is completed, a connection of which the download rate is the lowest is searched S1202. The download rate can be calculated by (the number of downloaded sub blocks)/(the number of requested sub blocks).

When the connection of which the download rate is the lowest is searched, the number of remaining sub blocks to be downloaded in the connection of which the download rate is the lowest is calculated S1204.

After the calculating the number remaining sub blocks in the connection of which the download rate is the lowest, it is determined if it is necessary to redistribute sub blocks to be downloaded between the connection where sub block download is completed and the connection of which the download rate is the lowest S1206. For example, if remaining sub blocks can be downloaded while transmitting control signal for redistributing sub blocks, redistribution of sub blocks would not be necessary.

If it is determined that redistribution of sub blocks is necessary, the sub blocks to be downloaded from the connection where sub block download is completed and the connection of which the download rate is the lowest is redistributed according to the connection state valuation index S1208.

Sub blocks are may be distributed by the following equation 3.

[equation 3]

$$P_1=[\frac{\alpha_1}{\alpha_1+\alpha_2}\times(the\ number\ of\ remaining\ sub\ blocks)$$

$$P_2=(the\ number\ of\ remaining\ sub\ blocks)\ -P_1$$

P_1 is the number of sub blocks redistributed to the connection of which the download rate is the lowest, α_1 is the connection state valuation index of the connection of which the download rate is the lowest, P_2 is the number of sub blocks redistributed to the connection where sub block download is completed, and the α_2 is the connection state valuation index of the connection where sub block download is completed.

If sub blocks are redistributed, sub blocks are requested to the node corresponding to each connection according to the new distribution result. If it is not necessary to download sub blocks from the connection of which the sub block download rate is the lowest, the user client requests stoppage of the sub block transmission to the corresponding node.

FIG. 13 is a block diagram of module of the connection control server according to a preferred embodiment of the present invention.

FIG. 13 illustrates module of the connection control server in the system of P2P network of FIG. 12 or in the system multiple servers and P2P are combined such as FIG. 4.

Referring to FIG. 13, the connection control server according to an embodiment of the present invention may comprise a mesh manager module 1300, a node information providing module 1302 and an authentication module 1304. A

user database 1306, a meta information data base 1308 and mesh information database may be coupled to the connection control server.

In FIG. 13, the mesh manager module 1300 manages information on user clients connected to the connection control server. As described above, when the power of the user client is on or the communication agent program is executed, client address information and information of contents stored in the client are transmitted to the connection control server, and the mesh manager module 1300 receives the information and stores it in the mesh information database 1310.

When a user requests specific contents, the node list providing module 1302 derives information of nodes that store the corresponding contents using the mesh information database 1310 and provides the derived information to the user client.

The authentication module 1304 authenticates users and processes billing information. When a user requests contents, authentication key information including user ID and password is transmitted to the connection control server, and the authentication module 1304 determines if the user is a registered user. Further, the authentication module 1304 determines if the user has paid for the contents by the communication with external billing server.

ID of registered users, password, personal information, etc. are stored in the user database 1306, and contents coding method, information of author, etc. is stored in the meta information database 1308. If the user who requests contents is authorized, the mesh manager module 1300 provides meta information to the user. Generally, meta information is necessary for play of the streaming data, however, if play of streaming data is possible without meta information, the meta information database 1308 may not be coupled to the connection control server.

Information of user clients connected to the connection control server and

information of contents stored in each of the user clients are stored in the mesh information database 1310.

FIG. 14 is a block diagram of the module of the connection control server according to another embodiment of the present invention.

Referring to FIG. 14, the connection control server may include a server state determining module 1400, a sub block distribution module 1402, a server list providing module 1404 and an authentication module 1406. A user database 1408, contents server database 1410 and meta information database 1412 may be coupled to the connection control server.

The server state determining module determines state information of contents servers which are managed by the connection control server. As described above, the server state determining module 1400 uses information including bandwidth, CPU usage rate, memory usage rate, the number of connected users, and file I/O, etc. in order to determine state of each of the contents servers.

The server list providing module 1404 provides list information of contents servers which the user client requesting contents should connect to. The server list providing module provides list of servers with good state using the determination result of the server state determining module.

The sub block distribution module 1402 provides information of the number of sub blocks to be downloaded from each of the contents servers using the state information of the contents servers to the user client which requested contents.

Information of contents servers which the connection control server manages is stored in the contents server database 1410.

Function of the authentication module 1406 and information stored in the user database 1408 and meta information database 1412 are same as the case of FIG.

13.

Industrial Applicability

As described above, according to the present invention, stable streaming service can be provided although error occurs in a connection, because streaming data are provided through multiple paths.

Further, according to the present invention, download efficiency can be improved by avoiding occurrence of idle connection because sub blocks to be downloaded are redistributed if sub block download in a connection is completed.

Especially, the present invention is useful when streaming data are downloaded through the plurality of nodes in P2P network.

WHAT IS CLAIMED IS:

1. A method for downloading streaming data comprising the steps of:

(a) establishing connections with a plurality of nodes;

(b) sending a request for sub blocks of streaming data to the plurality of nodes where connection is established to download the sub blocks;

(c) monitoring download state of the established connections; and

(d) redistributing sub blocks to be downloaded from some of the nodes where connection is established according to the monitoring result;

wherein, the step (b) to step (d) are repeated for downloading sub blocks included in next block when all sub blocks included in a block are downloaded.

2. The method of claim 1, further comprising the step of determining sub blocks to download from each of the nodes where connection is established.

3. The method of claim 1, wherein the step (c) comprises the step of monitoring if there exists a connection where sub block download is completed.

4. The method of claim 2, wherein the sub blocks to be downloaded from each of the nodes are determined by calculating connection state valuation index.

5. The method of claim 4, wherein the connection state valuation index is calculated using information selected from group consisting of round-trip time with each of the nodes and average download speed from each of the nodes.

6. The method of claim 3, wherein the step (d) comprises the step of redistributing sub blocks between a connection where sub block download is completed and some of the connections where sub block download is not completed when a connection where sub block download is completed exists.

7. The method of claim 6, wherein the step (d) comprises the step of redistributing sub blocks between a connection where sub block download is completed and a connection of which download rate is the lowest among connections where sub block download is not completed.

8. The method of claim 7, the step for redistributing sub blocks between a connection where sub block download is completed and a connection of which the download rate is the lowest comprises the steps of:

determining download speed of the connection where the sub block download is completed and the connection of which the download rate is the lowest;

determining the number of remaining sub blocks to download in the connection of which the download rate is the lowest;

determining if redistribution of sub blocks is necessary;

redistributing the remaining sub blocks between the connection where sub block download is completed and the connection of which the download rate is the lowest according to rate of the download speed if sub block redistribution is necessary.

9. The method of claim 1, further comprising the step of storing

information of nodes with which the connection establishment failed in a black list queue.

10. The method of claim 2, further comprising the step of receiving node state information, wherein the sub blocks to be downloaded from each of the nodes are determined using the node state information.

11. The method of claim 2, wherein sub blocks to be downloaded from each of the nodes are determined by state information of nodes in initial state of download, after determination of download speed from each of the nodes, sub blocks to be downloaded from each of the nodes are determined using connection state valuation index which is calculated using information selected from group consisting of round-trip time with each of the nodes and average download speed from each of the nodes.

12. The method of claim 10, wherein the connection establishment with the plurality of nodes are performed using state information of the nodes in step (a).

13. The method of claim 1, further comprising the step of determining download error using checksum value of downloaded sub blocks.

14. The method of claim 1, further comprising the step of sending a request for sub blocks to corresponding nodes by the redistribution result to download redistributed sub blocks after redistribution of sub blocks.

15. The method of claim 1, further comprising the step of downloading streaming data by connecting to a singular server if sub block download from the plurality of the nodes fails.

16. The method of claim 1, further comprising the steps of:

monitoring state information of nodes which are not transmitting data among nodes where connection is established;

redistributing sub blocks to be downloaded between some of the nodes which are transmitting data and some of the nodes which are not transmitting data.

17. A communication agent program installed in a plurality user clients in the system where a connection control server and the plurality of user clients are connected through network, comprising:

an agent manager module for providing information of contents stored in a user client and identification information of the user client to the connection control server and transmitting contents request information to the connection control server when a user requests contents;

a node information manager module for receiving and storing list information of nodes that store requested contents;

a connection control module for establishing connections with a plurality of nodes using the list information of nodes, and determining sub blocks to download from each of the nodes where connection is established to request sub blocks, and redistributing sub blocks to download from some of the connected nodes by monitoring download state while downloading sub blocks;

a sub block manager module for determining if all sub blocks included in a

block are downloaded and requesting sub blocks included in a next block to download sub blocks included in the next block when all sub blocks included in a block is downloaded.

18. The program of claim 17, wherein the connection control module redistributes sub blocks between a connection where sub block download is completed and some of the connections where sub block download is not completed.

19. The program of claim 18,

the communication agent module comprises,

a connection establishment module for establishing connections with nodes included in the node list.

a connection state determining module for determining connection state with nodes where connection is established;

a sub block distribution module for distributing sub blocks to be downloaded from nodes where connection is established using the connection state information;

a download state monitoring module for requesting redistribution of sub blocks between a connection where sub block download is completed and a connection of which the download rate is the lowest to the sub block distribution module when there exists a node which completed requested sub block transmission;

wherein the sub block distribution module redistributes sub blocks to be downloaded between the connection where sub block download is completed and

the connection of which the download rate is the lowest according to the download speed in response to the request for sub block redistribution by the download state monitoring module.

20. The program of claim 19, wherein connection state determining module determines connection state using information selected from group consisting of round-trip time with each of the nodes and average download speed from each of the nodes.

21. The program of claim 19, wherein the connection state determining module determines connection state by receiving node state information from the connection control server.

22. The program of claim 19, wherein the connection establishment module establishes connections using node state information provided from the connection control server, if connection establishment fails, the connection establishment module establishes connection with other nodes using the node state information.

23. The program of claim 19, the connection establishment module stores information of nodes with which connection establishment failed in a black list queue when connection establishment fails.

24. The program of claim 17, the sub block manager module determines download error using checksum value of sub blocks.

25. The program of claim 17, further comprising a cache manager module for storing the downloaded streaming data in scrambled state and managing the stored data.

26. The program of claim 25, further comprising a block manager module for providing block data to the cache manager module or to a player which plays streaming data when all sub blocks included in a block are downloaded.

27. The program of claim 17, further comprising a reservation manager module for transmitting reservation request information to the connection control server and managing reserved contents information.

28. The program of claim 17, wherein the connection control module monitors state of nodes which are not transmitting data among nodes where connection is established and redistributes sub blocks between some of the nodes which are not transmitting data and some of the nodes which are transmitting data according to the monitoring result.

29. A communication agent program installed in user clients downloading streaming data from system including a plurality of contents servers and at least a connection control server, comprising:

a data request module for sending a request for transmission of data to the connection control server;

a node information manager module for receiving and storing list of contents servers from which the requested data are to be downloaded;

a connection control module for establishing connections with a plurality of contents servers included in the contents server list, requesting sub blocks of streaming data to download from the contents servers where connection is established, and redistributing sub blocks to download in some of the contents servers where connection is established by monitoring download state while downloading sub blocks from connected contents servers; and

a sub block manager module for determining if all sub blocks included in a block are downloaded and requesting sub blocks included in a next block to download sub blocks of the next block when all sub blocks included in a block are downloaded.

30. The program of claim 29, wherein the connection control module redistributes sub blocks between a connection where sub block download is completed and some of the connections where sub block download is not completed.

31. The program of claim 30, wherein the connection control module comprises,

a connection establishment module for establishing connections with contents servers included in the contents server list;

a connection state determining module for determining connection state of connected contents servers;

a sub block distribution module for distributing sub blocks to be downloaded from each of the connected contents servers using the connection state information; and

a download state monitoring module for requesting redistribution of sub blocks between a connection where sub block download is completed and a connection of which the download rate is the lowest, when there exists a connection where sub block download is completed;

wherein the sub block distribution module redistributes sub blocks according to download speed of the connection where sub block download is completed and the connection of which the download rate is the lowest in response to the request of the download state monitoring module.

32. The program of claim 31, wherein the connection state determining module determines connection state using contents server state information provided from the connection control server.

33. A connection control server connected with a plurality of user clients through network for controlling connection between the user clients in order for a user client to download streaming data by connecting other user clients, comprising:

a mesh manager module for receiving information of contents stored in the connected plurality of user clients and address information of the connected plurality of user clients, and providing information of nodes that store requested contents to a user client which requested contents; and

a mesh information database for storing information of contents stored in each of the user clients and address information of each of the user clients;

wherein a communication agent program is installed in the plurality of user clients, the communication agent program controls user clients to establish connections with a plurality of nodes using the node information, and to send a

request for sub blocks of streaming data to download to the connected nodes, and to redistribute sub blocks to download by monitoring download state of each of the connected nodes.

34. The server of claim 33, further comprising an authentication module for authenticating users and processing billing information.

35. The server of claim 33, further comprising a user database for storing information of registered users and a meta information database for storing meta information of streaming data.

36. The server of claim 33, wherein the mesh manager module receives state information of each of the nodes and provides the state information with the node information.

37. A connection control server connected with a plurality of user clients and a plurality of contents servers through network for controlling connection between the user clients and the contents servers in order for a user client to download streaming data by connecting at least two contents servers, comprising:

a server state determining module for receiving state information from the connected plurality of contents servers and determining state of each of the contents servers;

a server list providing module for providing list information of servers to transmit streaming data of requested contents when receiving contents request information from a user client;

wherein a communication agent program is installed in the user clients, the communication agent program controls the user clients to establish connections with at least two contents servers using the server list information, and to determine sub blocks of streaming data to download from each of the connected contents servers to request sub blocks, and to redistribute sub blocks to download by monitoring download state of sub blocks from each of the connected nodes.

38. The server of claim 37, wherein the state information provided from the contents servers is selected form group consisting of bandwidth information, CPU usage information, memory usage information, the number of connected users, and file I/O information.

FIG. 1

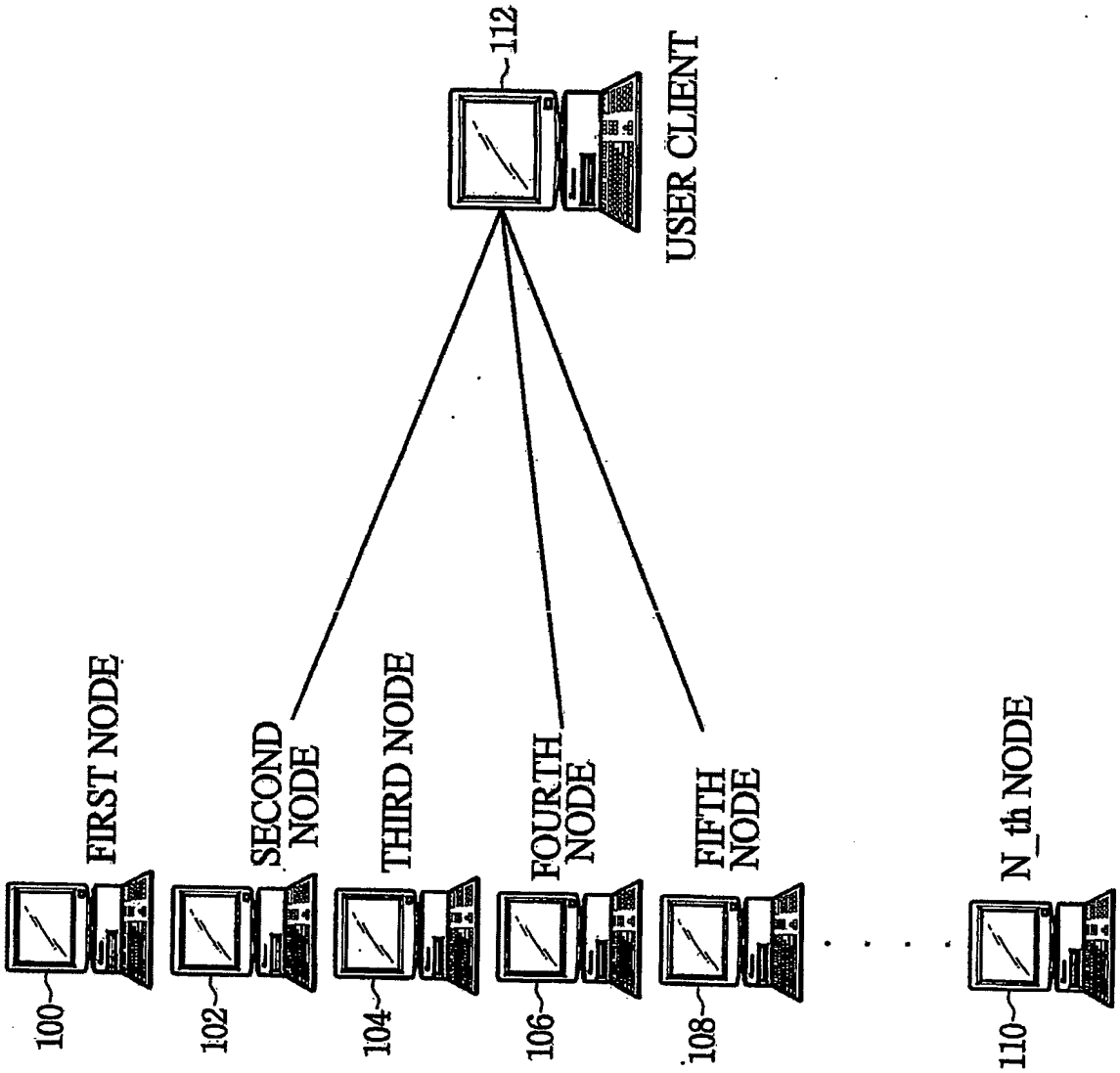

112
USER CLIENT
FIRST NODE
SECOND NODE
THIRD NODE
FOURTH NODE
FIFTH NODE
N_th NODE
100
102
104
106
108
110

FIG. 2

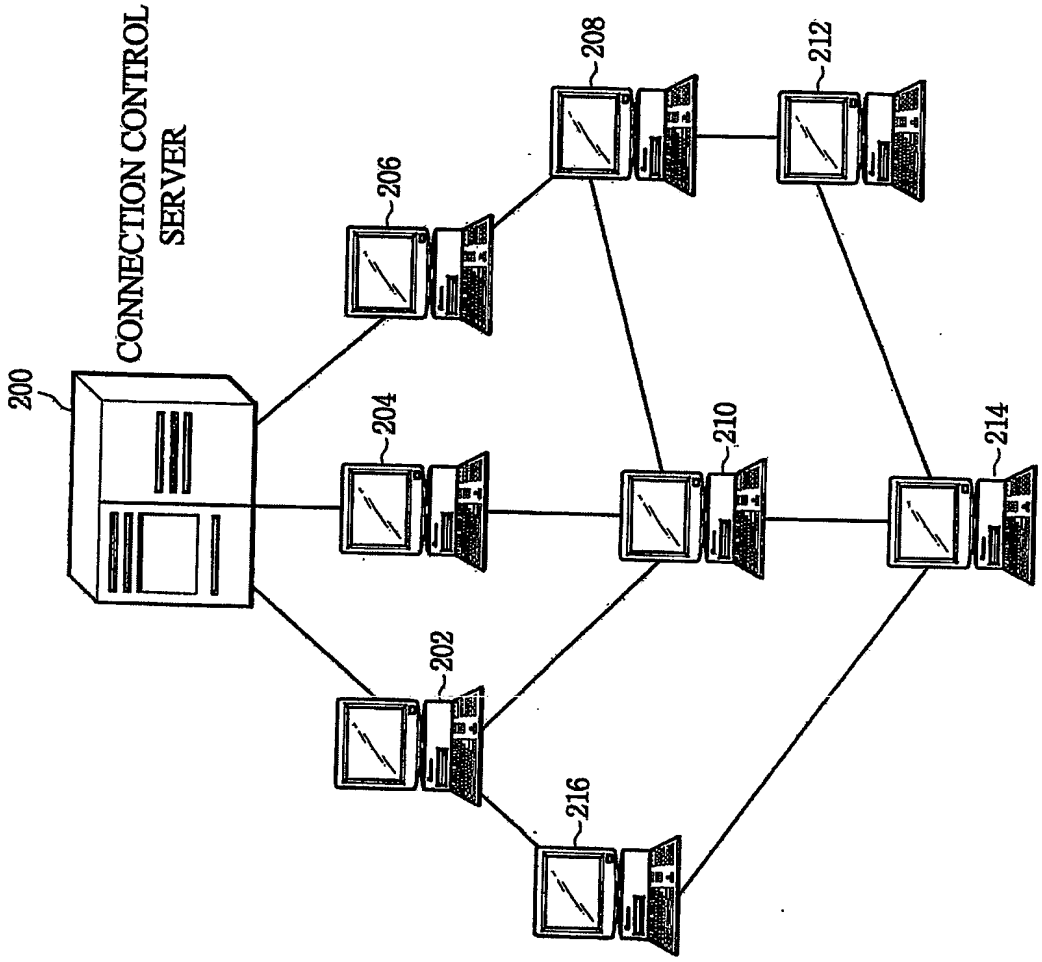

CONNECTION CONTROL SERVER
200
202
204
206
208
210
212
214
216

FIG. 3

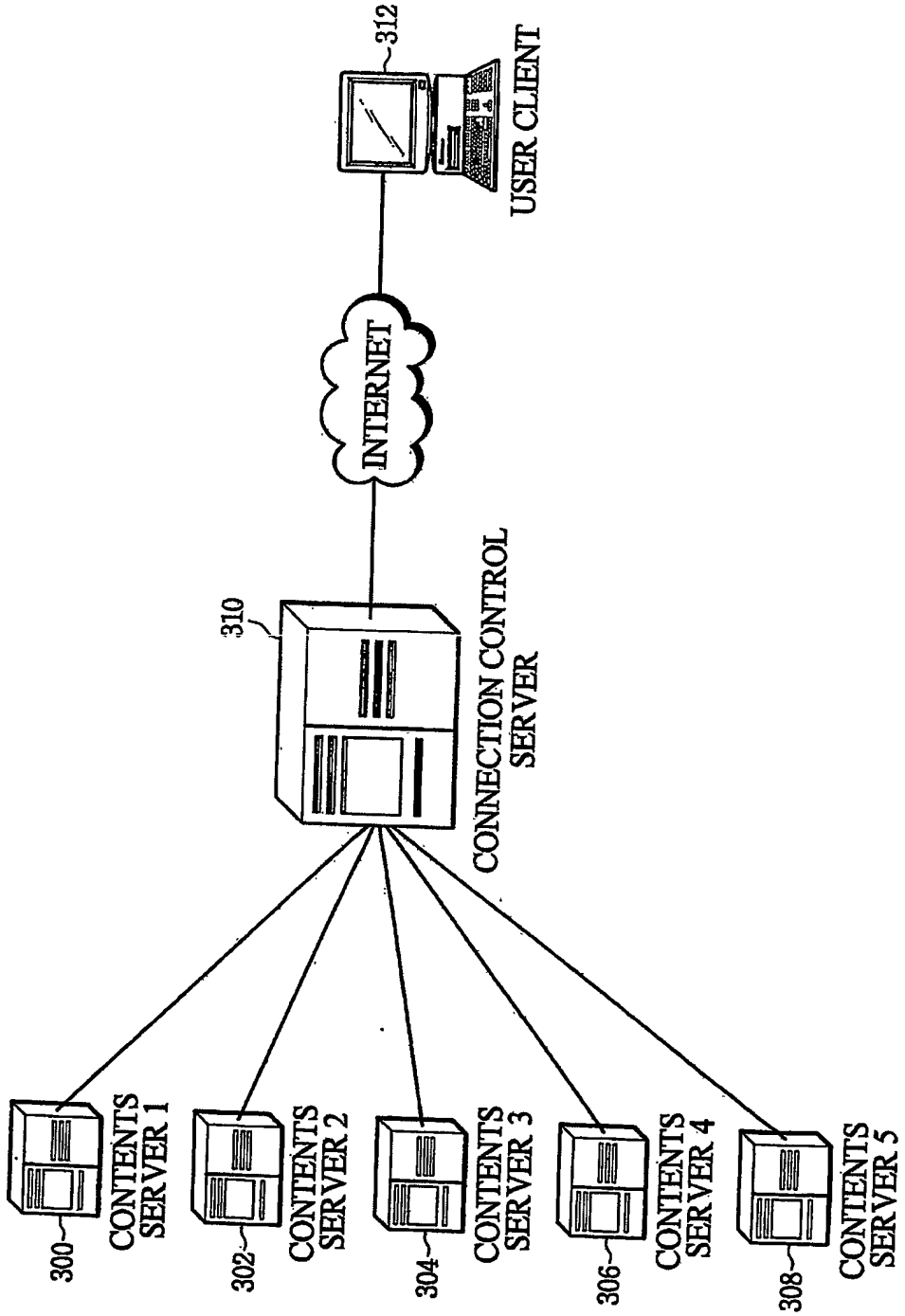

312
USER CLIENT
INTERNET
310
CONNECTION CONTROL SERVER
300
CONTENTS SERVER 1
302
CONTENTS SERVER 2
304
CONTENTS SERVER 3
306
CONTENTS SERVER 4
308
CONTENTS SERVER 5

FIG. 4

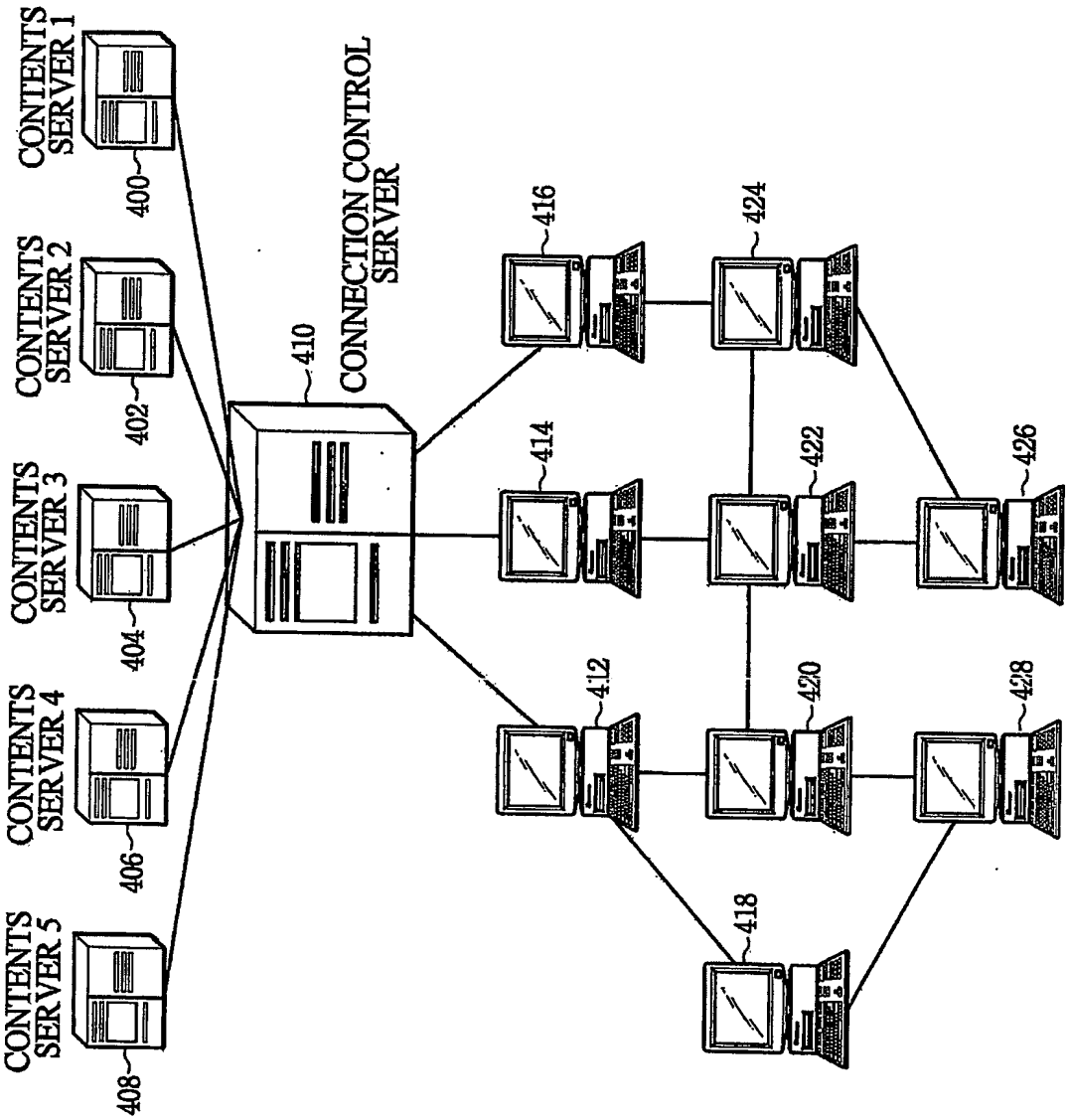

CONTENTS SERVER 1
400
CONTENTS SERVER 2
402
CONTENTS SERVER 3
404
CONTENTS SERVER 4
406
CONTENTS SERVER 5
408
410
CONNECTION CONTROL SERVER
412
414
416
418
420
422
424
426
428

FIG. 5

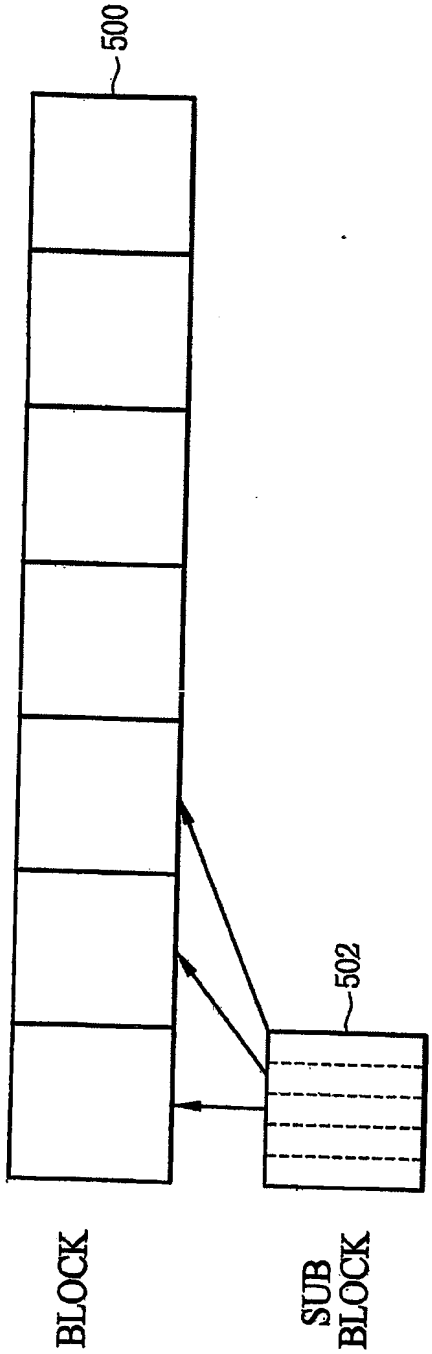


FIG. 6

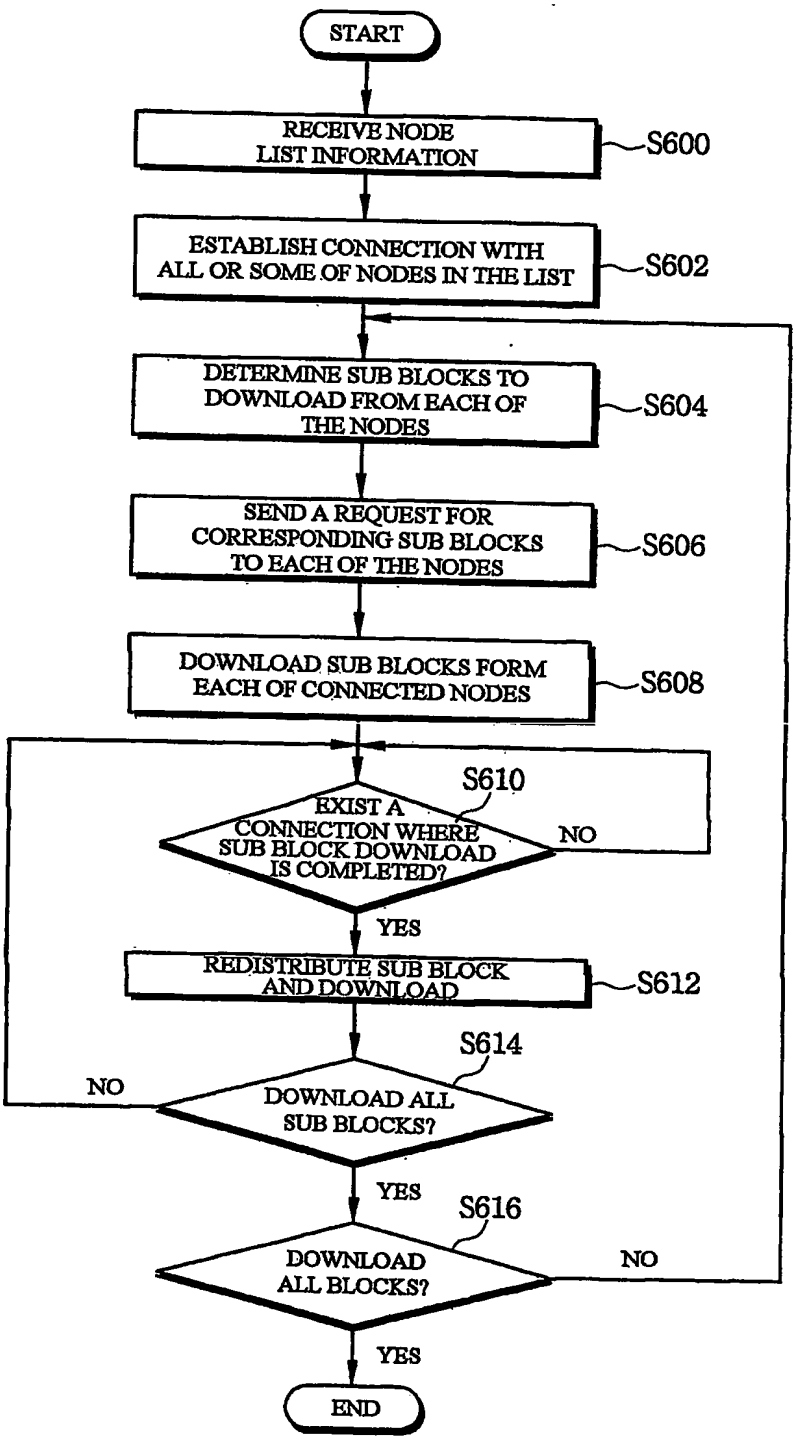

START
RECEIVE NODE LIST INFORMATION
S600
ESTABLISH CONNECTION WITH ALL OR SOME OF NODES IN THE LIST
S602
DETERMINE SUB BLOCKS TO DOWNLOAD FROM EACH OF THE NODES
S604
SEND A REQUEST FOR CORRESPONDING SUB BLOCKS TO EACH OF THE NODES
S606
DOWNLOAD SUB BLOCKS FORM EACH OF CONNECTED NODES
S608
S610
EXIST A CONNECTION WHERE SUB BLOCK DOWNLOAD IS COMPLETED?
NO
YES
REDISTRIBUTE SUB BLOCK AND DOWNLOAD
S612
S614
NO
DOWNLOAD ALL SUB BLOCKS?
YES
S616
DOWNLOAD ALL BLOCKS?
NO
YES
END

FIG. 7

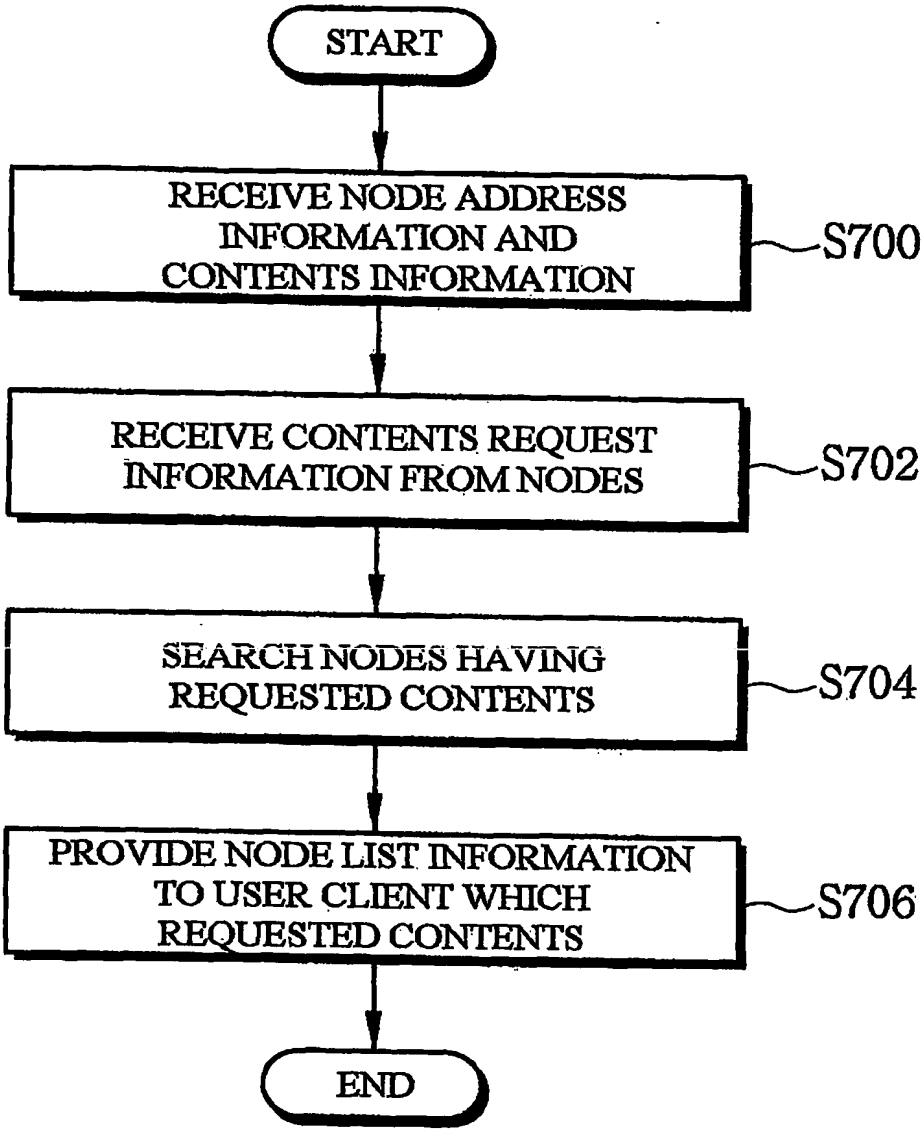

START
RECEIVE NODE ADDRESS INFORMATION AND CONTENTS INFORMATION
S700
RECEIVE CONTENTS REQUEST INFORMATION FROM NODES
S702
SEARCH NODES HAVING REQUESTED CONTENTS
S704
PROVIDE NODE LIST INFORMATION TO USER CLIENT WHICH REQUESTED CONTENTS
S706
END

FIG. 8

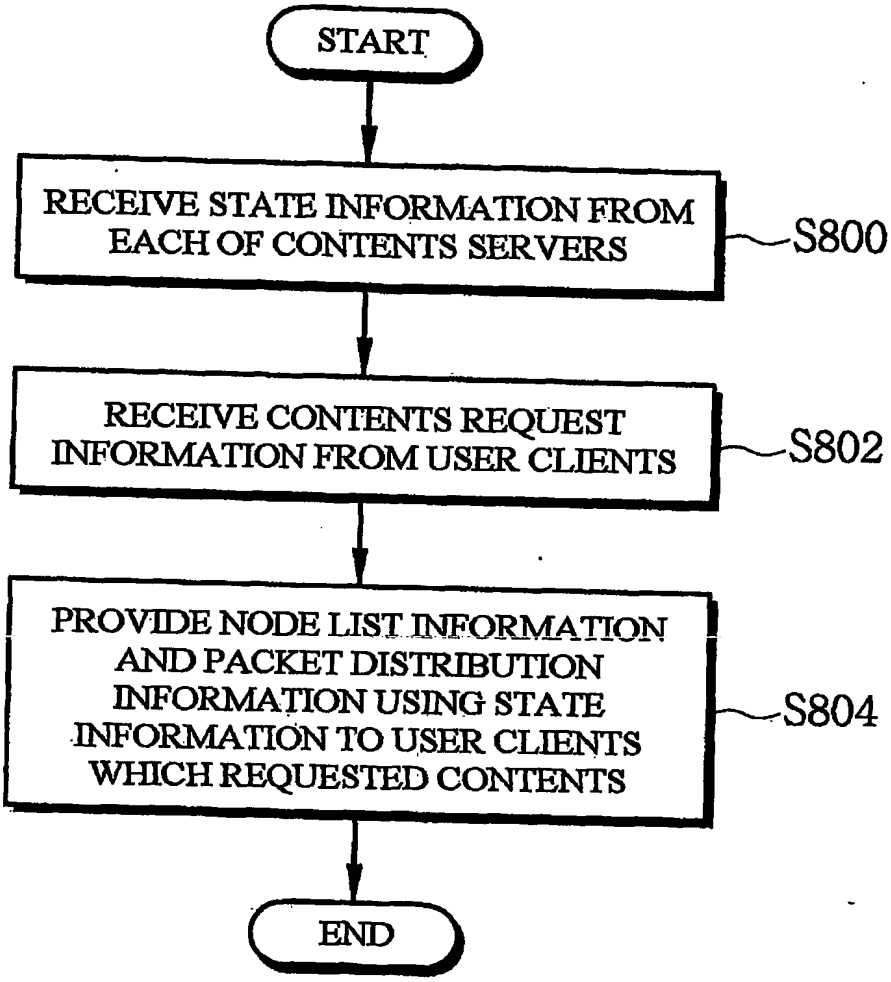

START
RECEIVE STATE INFORMATION FROM EACH OF CONTENTS SERVERS
S800
RECEIVE CONTENTS REQUEST INFORMATION FROM USER CLIENTS
S802
PROVIDE NODE LIST INFORMATION AND PACKET DISTRIBUTION INFORMATION USING STATE INFORMATION TO USER CLIENTS WHICH REQUESTED CONTENTS
S804
END

FIG. 9

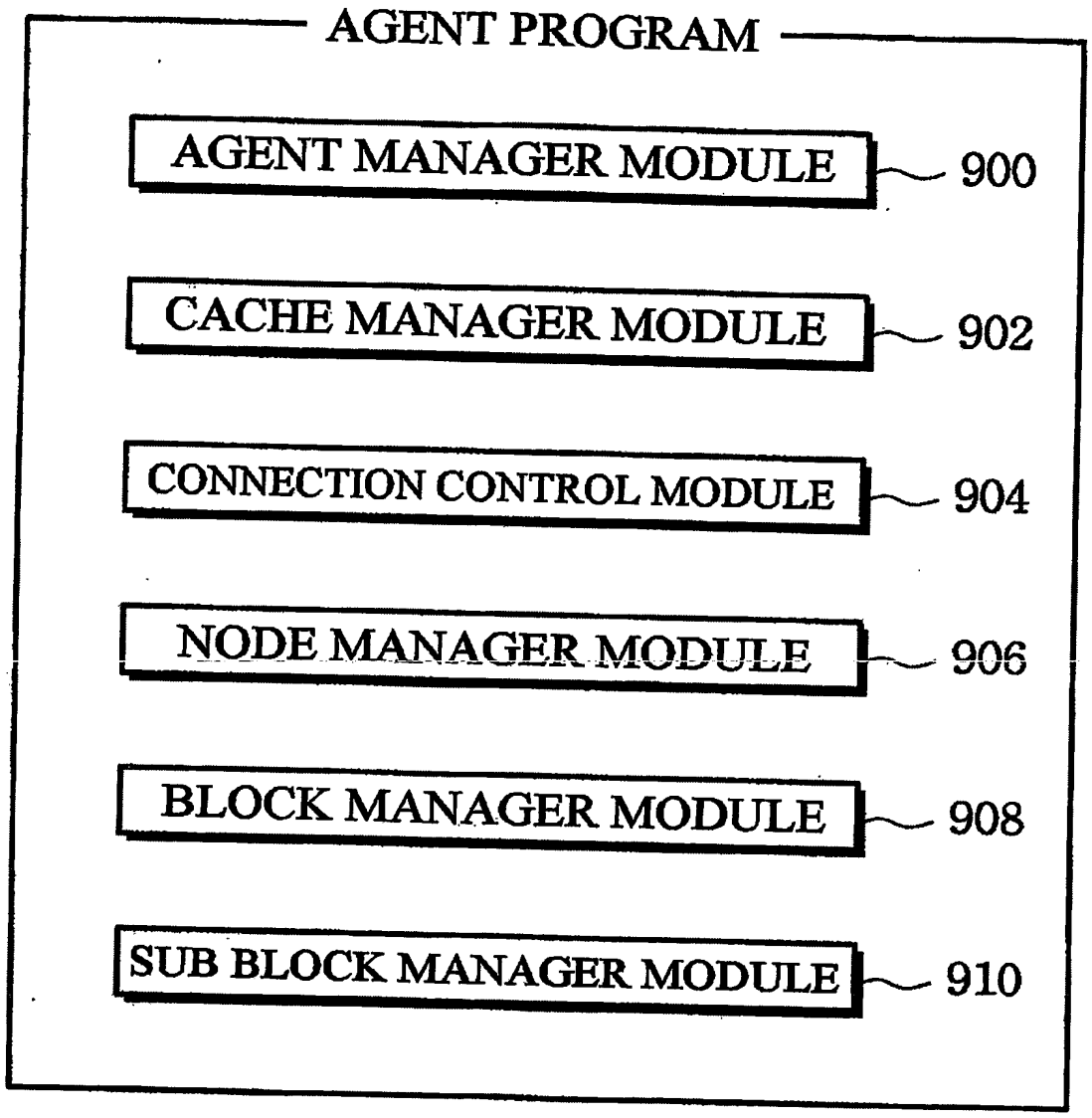

AGENT PROGRAM
AGENT MANAGER MODULE
900
CACHE MANAGER MODULE
902
CONNECTION CONTROL MODULE
904
NODE MANAGER MODULE
906
BLOCK MANAGER MODULE
908
SUB BLOCK MANAGER MODULE
910

FIG. 10

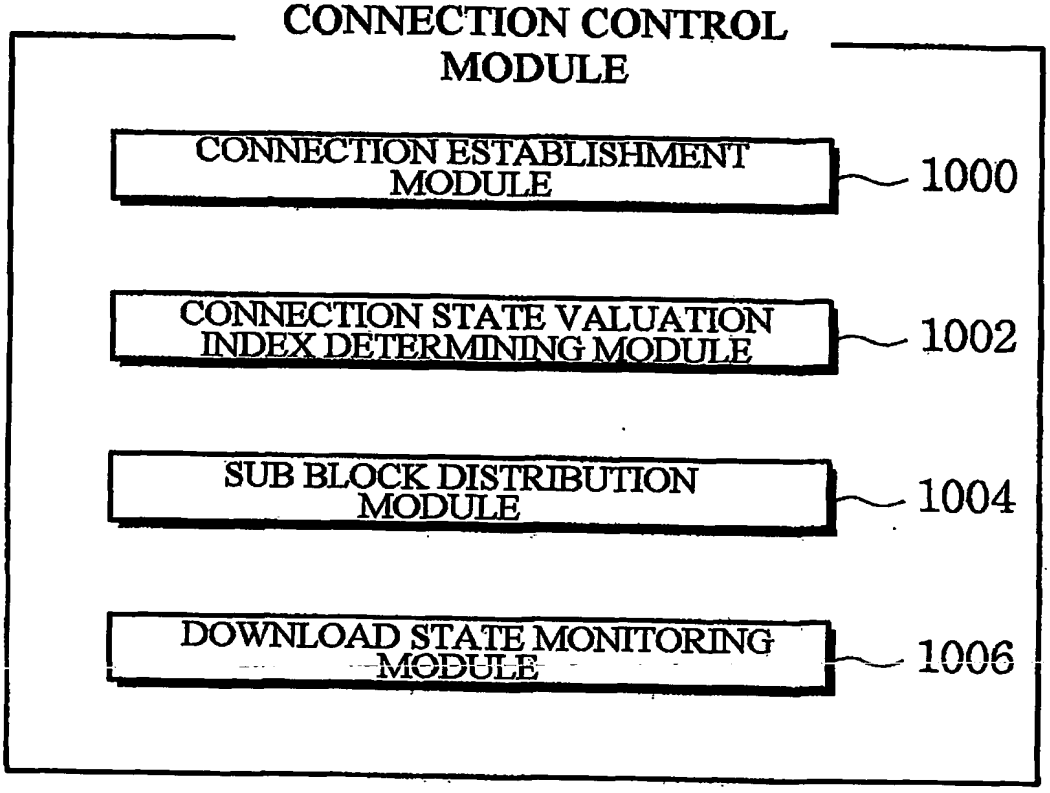

CONNECTION CONTROL MODULE
CONNECTION ESTABLISHMENT MODULE
1000
CONNECTION STATE VALUATION INDEX DETERMINING MODULE
1002
SUB BLOCK DISTRIBUTION MODULE
1004
DOWNLOAD STATE MONITORING MODULE
1006

FIG. 11

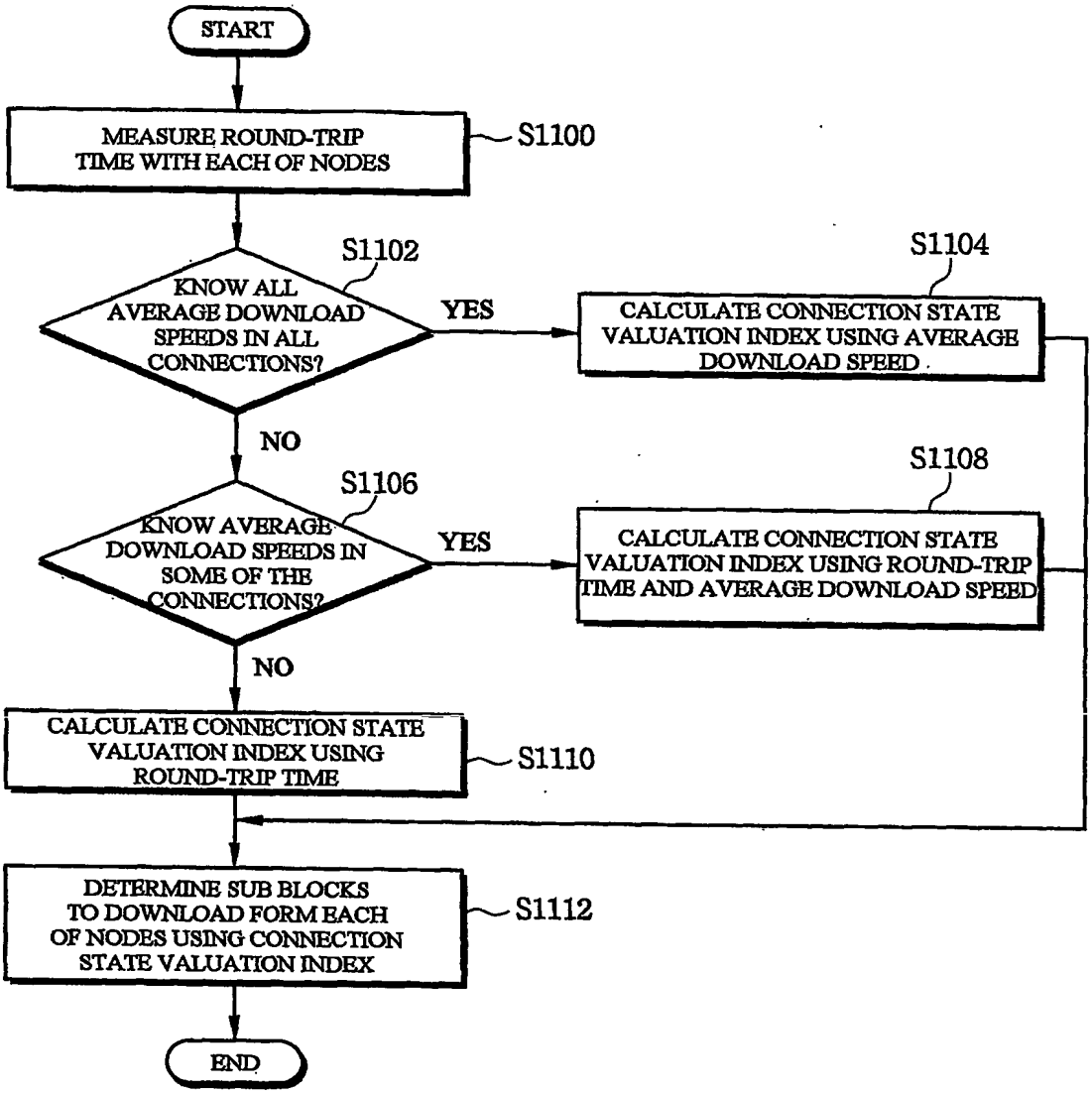

START
MEASURE ROUND-TRIP TIME WITH EACH OF NODES
S1100
S1102
KNOW ALL AVERAGE DOWNLOAD SPEEDS IN ALL CONNECTIONS?
YES
S1104
CALCULATE CONNECTION STATE VALUATION INDEX USING AVERAGE DOWNLOAD SPEED
NO
S1106
KNOW AVERAGE DOWNLOAD SPEEDS IN SOME OF THE CONNECTIONS?
YES
S1108
CALCULATE CONNECTION STATE VALUATION INDEX USING ROUND-TRIP TIME AND AVERAGE DOWNLOAD SPEED
NO
CALCULATE CONNECTION STATE VALUATION INDEX USING ROUND-TRIP TIME
S1110
DETERMINE SUB BLOCKS TO DOWNLOAD FORM EACH OF NODES USING CONNECTION STATE VALUATION INDEX
S1112
END

FIG. 12

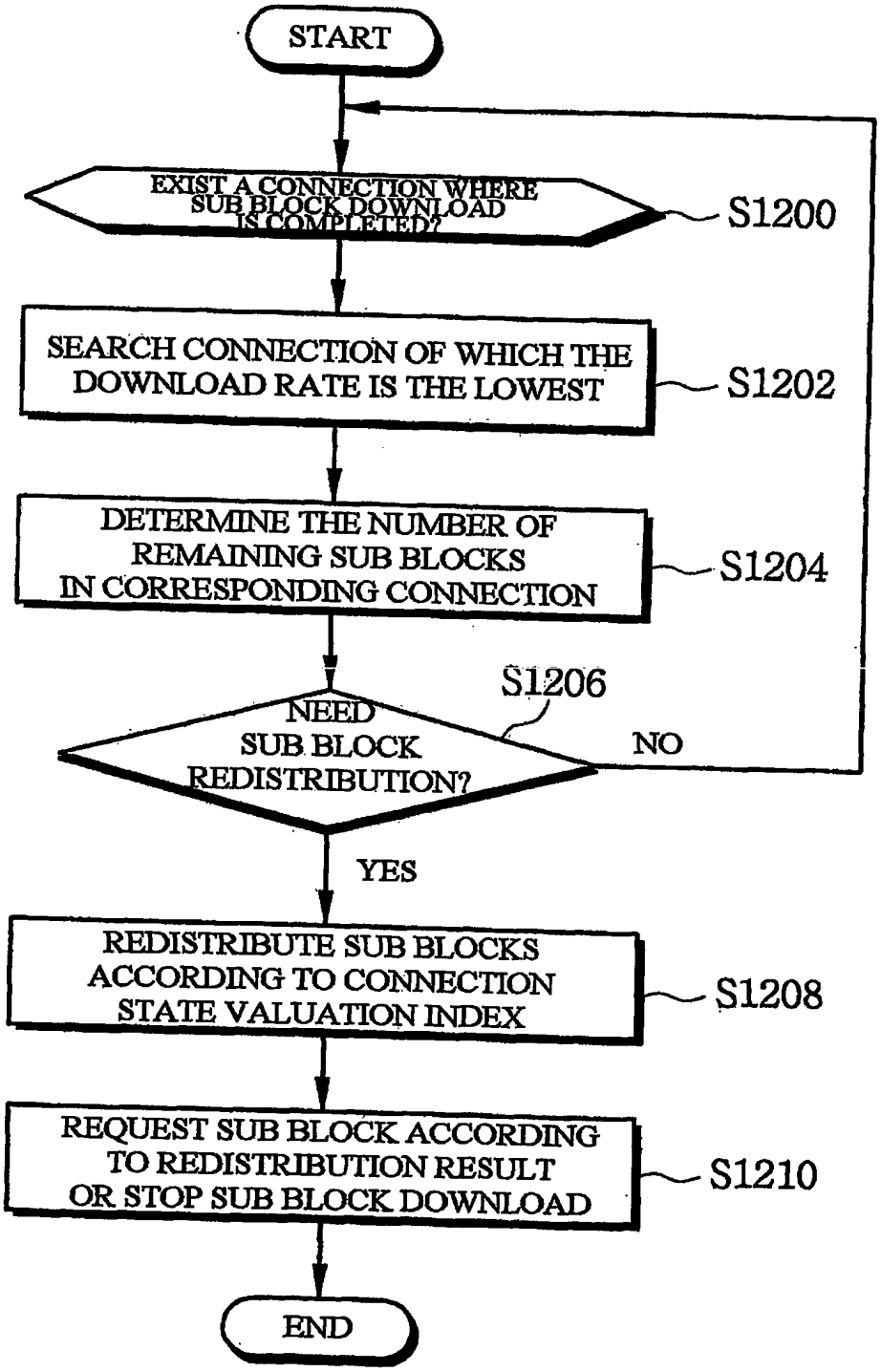

START
EXIST A CONNECTION WHERE SUB BLOCK DOWNLOAD IS COMPLETED?
S1200
SEARCH CONNECTION OF WHICH THE DOWNLOAD RATE IS THE LOWEST
S1202
DETERMINE THE NUMBER OF REMAINING SUB BLOCKS IN CORRESPONDING CONNECTION
S1204
S1206
NEED SUB BLOCK REDISTRIBUTION?
NO
YES
REDISTRIBUTE SUB BLOCKS ACCORDING TO CONNECTION STATE VALUATION INDEX
S1208
REQUEST SUB BLOCK ACCORDING TO REDISTRIBUTION RESULT OR STOP SUB BLOCK DOWNLOAD
S1210
END

FIG. 13

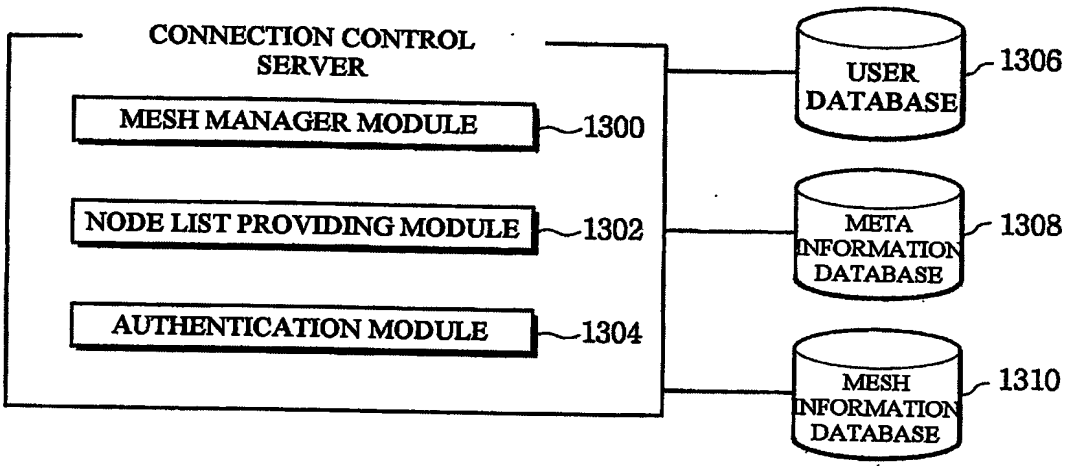
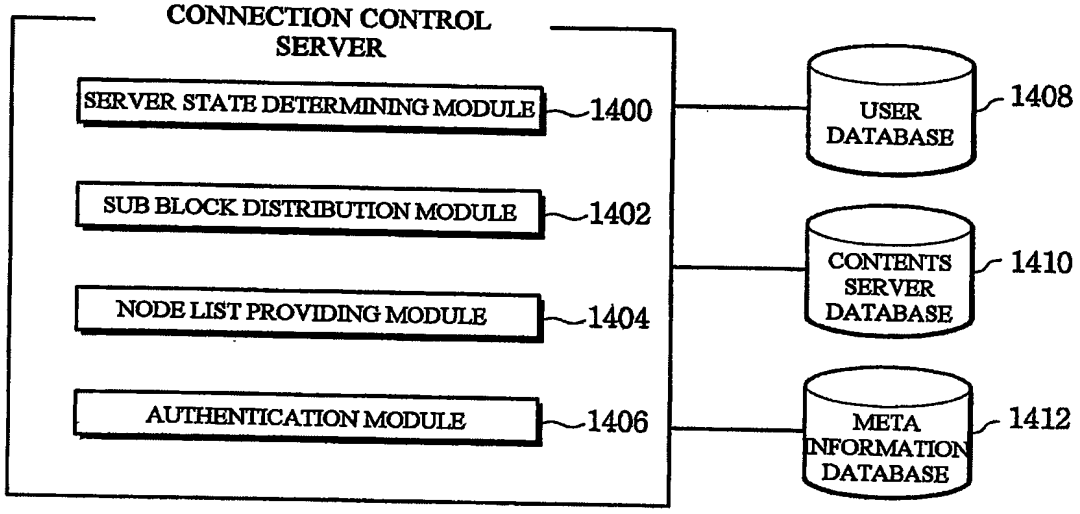

CONNECTION CONTROL SERVER
MESH MANAGER MODULE
1300
NODE LIST PROVIDING MODULE
1302
AUTHENTICATION MODULE
1304
USER DATABASE
1306
META INFORMATION DATABASE
1308
MESH INFORMATION DATABASE
1310

FIG. 14


CONNECTION CONTROL SERVER
SERVER STATE DETERMINING MODULE
1400
SUB BLOCK DISTRIBUTION MODULE
1402
NODE LIST PROVIDING MODULE
1404
AUTHENTICATION MODULE
1406
USER DATABASE
1408
CONTENTS SERVER DATABASE
1410
META INFORMATION DATABASE
1412

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2004/000007

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 G06F 17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC7 G06F17/00, G06F19/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
KR, JP : IPC as above

Electronic data base consulted during the internationl search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR10-2002-57837 A (MUN YEUSUN) 12. JULY. 2002 See the whole document	1-38
A	KR10-2001- 62171 A (SONY CO. LTD.) 07. JULY. 2001. See the whole document	1-38
A	KR10-2002-17926 A (FILAMENT NETWORKS CO. LTD.) 07. MARCH. 2002 See the whole document	1-38
A	KR10-2003-1527 A (GENERAL INSTRUMENT CO. LTD.) 06. JAN. 2003 See the whole document	1-38

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 FEBRUARY 2004 (20.02.2004)	22 MARCH 2004 (22.03.2004)
Name and mailing address of the ISA/KR Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer SONG, Dae Jong Telephone No. 82-42-481-5992

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